The Challenges and Barriers Faced in Implementing Circular Economy Practices in Waste Management in Karu LGA of Nasarawa State, Nigeria

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ABSTRACT

The transition to a circular economy (CE) in waste management faces diverse challenges, particularly in Karu Local Government Area. This study investigates the barriers impeding the effective implementation of CE principles, drawing on survey data, comparative and descriptive analysis. The study adopted quantitative data collection and analysis methods. The sources of data used in this research work are primary, and secondary data. Questionnaires were used to collect primary data while secondary data included reviews of existing literature, policy documents, and reports. An estimated number of 400 questionnaire respondents were gathered. The results indicate that low public awareness (44%) constitutes the most significant barrier to effective waste management, followed by inadequate infrastructure (29.8%), insufficient funding (15.5%), and certain government policies (10.8%). Additionally, a substantial proportion of respondents reported encountering misinformation or misunderstandings regarding waste management practices, with 73.5% experiencing such issues occasionally or more frequently. In terms of community receptiveness to CE principles, 49.8% of respondents expressed a moderate willingness to adopt new waste management practices, suggesting cautious optimism for behavioral change. Notably, public resistance to change (32.3%) emerged as the predominant challenge in transitioning to a CE framework, alongside technological limitations (32%) and funding shortages (21.3%). The successful implementation of circular economy principles in Karu LGA is currently hindered by factors including low public awareness, infrastructural deficits, misinformation, resistance to behavioral change, inadequate funding, and lack of enabling policies and technologies. This reinforces the need for targeted policy measures towards increased public education, investment in infrastructure and technology, and the development and strengthening policy implementation towards facilitating the sustainable transition to a circular economy in Karu, Nasarawa State.

Keywords: Circular Economy, Waste Management, Challenges, Barriers, Nigeria

INTRODUCTION

Waste is a pressing environmental, social, and economic issue, and one of the biggest challenges faced by every urban area in the world [23],[25]. Waste management has been widely recognized as a technical problem that is strongly influenced by various political, legal, sociocultural, environmental, and economic factors and by resources available to tackle it [25],[20]. Waste management practices play a crucial role in shaping the environmental sustainability of our societies [17]. However, the current approaches to waste management often fall short in addressing the growing challenges posed by escalating waste generation and its negative impacts on the environment [21]. Although many studies show that waste management is important and influenced by different factors, most focus too much on technical solutions. There is still a gap understanding its social, political, and community aspects, which are key to making waste management more effective and sustainable.

The prevailing waste management practices primarily follow a linear model, commonly known as the "take-make-dispose" paradigm. To address the shortcomings of current waste management practices, transitioning to a circular economy is imperative [4]. Nowadays waste has become a vital part of our economy, being a by-

product of economic activity and originating from businesses, the government and households; at the same time, it can be used as an input to economic activity for instance through material or energy recovery [3]. A circular economy aims to close the loop by minimizing waste generation, maximizing resource efficiency, and promoting the continual use and regeneration of materials [13]. Adopting a circular economy for waste management offers opportunities for reduced waste generation, enhanced recycling and reuse, and the development of innovative business models that create value from waste [24].

The circular economy is a model of production and consumption, which involves sharing, leasing, reusing, repairing, refurbishing and recycling existing materials and products as long as possible [7]. In this way, the lifecycle of products is extended in practice, it implies reducing waste to a minimum. When a product reaches the end of its life, its materials are kept within the economy wherever possible thanks to recycling. This is a departure from the traditional, linear economic model, which is based on a take-make-consume-throw away pattern [14]. This model relies on large quantities of cheap, easily accessible materials and energy.

Reusing and recycling products would slow down the use of natural resources, reduce landscape and habitat disruption and help to limit biodiversity loss [4]. Another benefit from the circular economy is a reduction in total annual greenhouse gas emissions. According to the European Environment Agency (2022), industrial processes and product use are responsible for 9.10% of greenhouse gas emissions in the EU, while the management of waste accounts for 3.32% [8]. Creating more efficient and sustainable products from the start would help to reduce energy and resource consumption, as it is estimated that more than 80% of a product's environmental impact is determined during the design phase. A shift to more reliable products that can be reused, upgraded and repaired would reduce the amount of waste. The aim is to tackle excessive packaging and improve its design to promote reuse and recycling [7]. It is empirically justified that circular economy offers a sustainable alternative to the existing resource-intensive linear model by promoting reuse, recycling, and waste minimization, however its effective implementation remains limited leaving.

The circular economy (CE) has been proposed as a response to the unsustainable, conventional ‘take-make-dispose’ economic model. The broader aim lies in simultaneously creating environmental quality, economic prosperity and social equity, however, some definitions of CE mistake it as being limited exclusively to recycling [14]. The main objective in the CE is to restore and regenerate material cycles, i.e., to maintain the value of materials at each point in a product’s life, minimize the generation of waste and eventually close the loop of materials through high value recycling [6],[5]. The CE is enabled by novel business models and focuses on solutions instead of products, and makes its profits from sufficiency, but also by keeping materials in the cycle. Currently, the global economy has been estimated to be less than 10% circular and the management of linear material flows is the current mainstream. As only a minor shift from a linear and moderate recycling system to more circularity-based use of materials has been observed by recent research, current practices of waste management do not yet support the CE concept as a whole and new solutions in treating and using waste have not yet been identified. Nevertheless, waste management is considered to play a significant role in the transition towards a CE were using design to eliminate waste, regenerating biological materials and restoration of technological materials are the key principles [11]. Since the global adoption of circular economy is still limited, it indicates a gap in integrating design-driven solutions, effective waste treatment methods, and establishing systemic frameworks that fully support circular transitions.

Karu Local Government Area of Nasarawa State is a rapidly urbanizing region that faces significant waste management challenges due to population growth, poor planning, and inadequate waste collection systems [18]. While circular economy offers a framework to transform waste into resources, reduce environmental degradation, and promote sustainable livelihoods, its practical implementation in Karu LGA is minimal. There is also limited empirical evidence on the specific challenges and barriers that hinder the adoption of CE principles in waste management [1], [9]. The objective of this study is to evaluate the challenges and barriers faced in implementing circular economy principles in waste management within the study area.

Study Area

Karu local government area is among the 13 LGA of Nasarawa State, a state sharing borders with Kaduna on

the North. Plateau to the east, Taraba and Benue State in the south with Kogi and F.C.T to the West [22]. Karu LGA is the second largest LGA in terms of landmass after Nasarawa with Area coverage of about 2810.39 square kilometer, which makes it the third largest local government area after Nasarawa and Lafia [22]. Karu Local Government Area of Nasarawa State is located between latitudes 8 5* N and 10 42' N and longitudes 9 25'E and 7 54'E of the Greenwich Meridian. lt extends from the eastern boundary of the Federal Capital Territory Abuja (Old Nyanya) to Gora about 15 kilometers to Keffi [12].

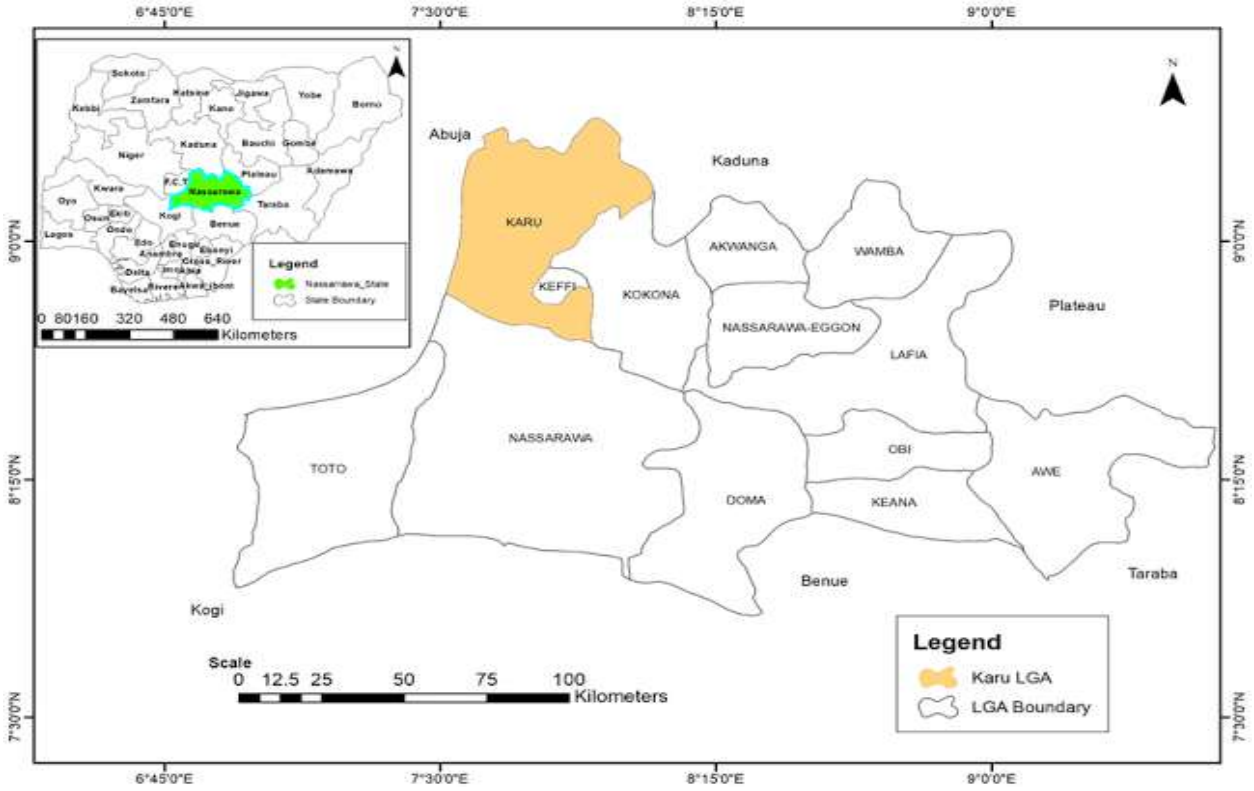

Fig 1. Nasarawa State showing Karu LGA

Source: Nasarawa State Ministry of Land and Survey (2016).

METHODOLOGY

The study adopted a mixed-methods approach combining both qualitative and quantitative data collection and analysis methods. The Quantitative Approach employed survey research using a structured questionnaire to collect data from a representative sample of residents and waste management stakeholders in the study area.

The total population of the study area is approximately 333,800 according to the report of National Bureau of Statistics 2022. Sampling Frame includes Waste management stakeholders in the study area, including Residents, Waste Management Operators, Government Officials, Community Leaders and Business Owners. A total of 400 questionnaire responses were collected. Stratified random sampling technique was used for the questionnaire survey. Data was analyzed and interpreted thematically using descriptive statistics, which include simple percentage, frequency distribution and charts using SPSS.

RESULTS AND DISCUSSION

4.1. Barriers to Effective Waste Management

In terms of barriers to effective waste management, 15.5% of respondents identified lack of funding, 44% attributed the issue to low public awareness, 29.8% cited insufficient infrastructure, and 10.8% pointed to government regulations. These findings suggest that low public awareness is the most significant barrier to effective waste management, as shown in Figure 2.

In a similar study by [10] on barriers to effective waste management, the results were somewhat aligned, though with differences in the perceived importance of the barriers. These findings underscore the consensus that low public awareness remains a major barrier to effective waste management, although different studies may slightly vary in their emphasis on funding, infrastructure, and regulation.

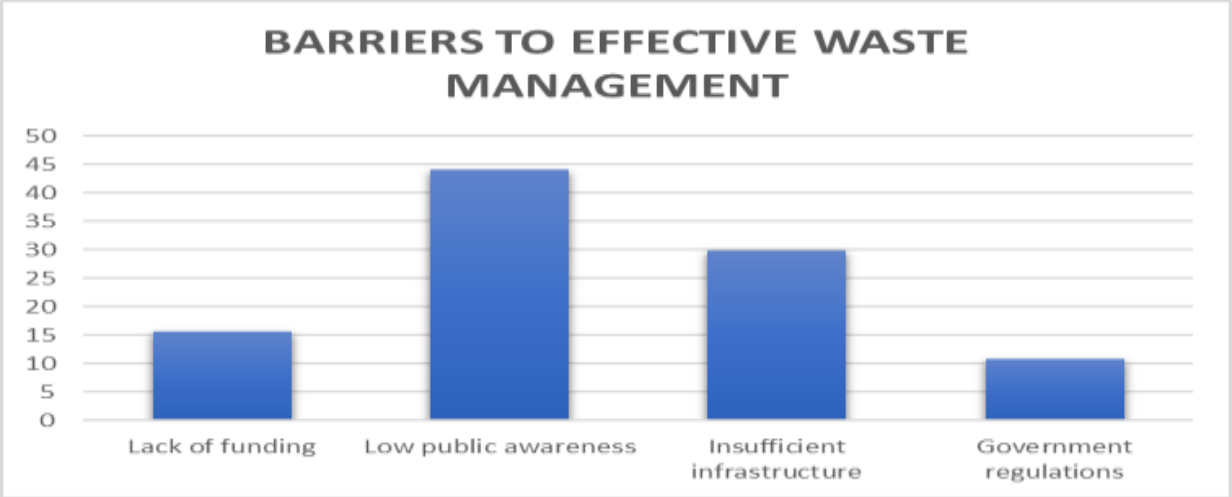

Figure 2. Barriers to Effective Waste Management

4.2. Information Regarding Waste Management Practices

The survey also assessed the frequency of misinformation or misunderstandings related to waste management practices. The responses indicated that 12.5% of respondents faced this issue very often, 25.5% often, 35.5% occasionally, and 7% rarely, indicating that many individuals in the study area frequently encounter a lack of information or misunderstandings in waste management, as shown in Figure 3. Misinformation—defined as the deliberate or accidental spread of false or misleading information that shapes incorrect beliefs or decisions [28],[27] —likely contributes to these frequent misunderstandings, highlighting how the circulation of false information and entrenched ideological resistance can misguide the public and impede proper waste management practices.

In a similar study by [2] on public perceptions of waste management information, the results regarding misinformation and misunderstandings were comparable, though some differences were evident in the frequency of encounters. In their research, 14% of respondents reported facing misinformation "very often," The percentage of respondents who faced misinformation "often" at 30%, 36% reported encountering misinformation "occasionally," only 4% reported encountering misinformation "rarely. These findings underscore a shared concern that misinformation and misunderstandings about waste management practices are prevalent, though the frequency and impact might differ slightly across different regions or populations.

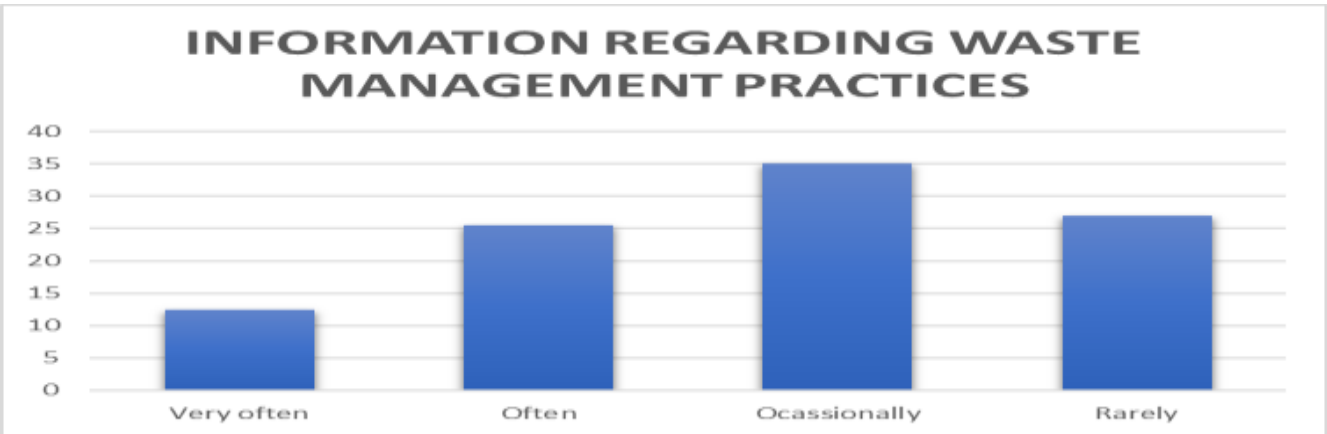

Figure 3. Information Regarding Waste Management Practices

4.3. Perception of Community's Willingness to Adopt New Waste Management Practices

When asked about the community's willingness to adopt new waste management practices, 24.3% of respondents were very willing, 49.8% were somewhat willing, and 26% were not willing, as shown in Figure 4 Implying that most community members were somewhat willing to adopt new waste management practices.

In a study by Martinez et al. (2021), respondents were asked about their willingness to adopt new waste management practices, and the results showed a somewhat similar trend but with slight variations in the distribution of responses [16]. These results highlight that while there is a general willingness to embrace new waste management practices, the degree of commitment and acceptance varies, and different regions or contexts may exhibit differing levels of enthusiasm for change.

Figure 4 Perception of Community's Willingness to Adopt New Waste Management Practices

4.4. Challenge in Transitioning to a Circular Economy in Waste Management

Regarding the challenges of transitioning to a circular economy in waste management, respondents highlighted funding shortages (21.3%), lack of technology (32%), public resistance to change (32.3%), and insufficient government policies (14.5%). Public resistance to change emerged as the most significant challenge, as shown in Figure 5. This means that most people might be unwilling to change their attitude towards waste management and be somewhat reluctant to adopting circular economy.

Likewise, in a study by Owojori et al., 2022, on Student's Knowledge, Attitude, and Perception (KAP) to Solid Waste Management: A Survey towards a More Circular Economy from a Rural-Based Tertiary Institution in South Africa [19]. The major barriers identified in transitioning to a circular economy were Students' lack of awareness of CE, Students' lack of knowledge on CE practicability, Limited budget and financial constraint and Lack of tools (standard waste separation bins). In a study by Kumar et al. (2022) on the challenges of transitioning to a circular economy in waste management, similar barriers were identified, but with some differences in their relative significance [15]. These findings corroborate the current study's conclusion that public resistance to change is a primary challenge in transitioning to a circular economy in waste management, although the emphasis on other factors such as government policies and technology may vary.

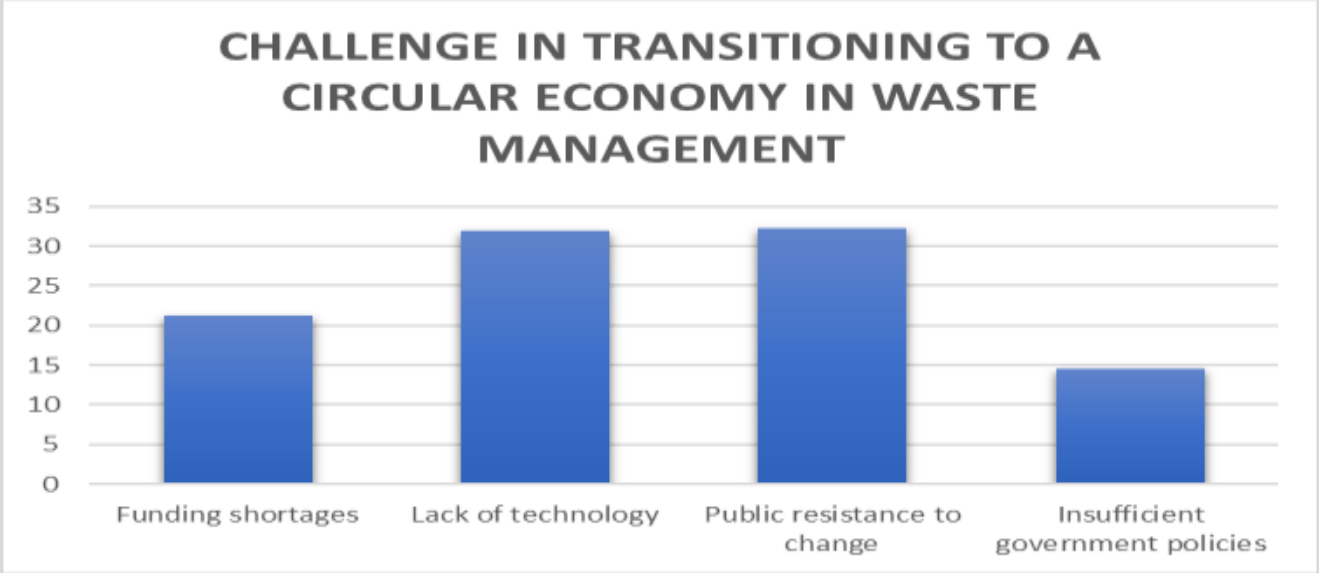

Figure 5. Challenge in Transitioning to a Circular Economy in Waste Management**.**

CONCLUSION AND RECOMMENDATIONS

This study reveals that while there is moderate community willingness to adopt improved waste practices in Karu LGA, the transition to a circular economy is constrained by systemic barriers such as low public awareness, inadequate waste management infrastructure, limited funding, misinformation, and weak policy support. The findings highlight that technical interventions alone are insufficient; sustainable adoption of circular economy principles also requires socio-cultural and institutional transformations to overcome behavioral resistance, strengthen governance frameworks, and build community trust. Addressing public resistance emerges as a critical priority for effective and lasting circular economy adoption. This study is limited by its geographic focus on Karu LGA, reliance on self-reported data, and its cross-sectional nature, which does not capture long-term changes. Further studies should also explore how behavioral factors such as misinformation, cultural perceptions, and resistance to change influence participation, as well as investigate the role of emerging technologies and digital tools in strengthening circular economy practices. Addressing public resistance and closing awareness gaps should therefore be prioritized in policy design, alongside investments in infrastructure and funding mechanisms that enable community participation. For policymakers, this highlights the need for integrated strategies that combine regulatory measures, public education, and incentives to promote long-term behavioral change.

Recommendations include:

1. Public Awareness and Education: There is a strong need to prioritize sustained community education programs to raise awareness about circular economy practices such as recycling, composting, and re-use. Leverage on schools, religious institutions, and community leaders as trusted channels for outreach to encourage behavioral change.

2. Improved Waste Collection and Infrastructure: Establish regular and efficient waste collection services and invest in decentralized sorting and recycling centers. Promote public-private partnerships (PPP) to finance infrastructure such as composting units, recycling plants, and waste-to-energy facilities. Provide incentives for businesses to adopt sustainable waste practices, including tax breaks or recognition schemes.

3. Collaboration among Stakeholders: Foster coordinated action between local government, private companies, community organizations, and educational institutions in implementing recycling, composting, and innovation-driven projects. Encourage partnerships with youth and women-led enterprises through training and access to microfinance.

4. Technology and Monitoring Systems: Deploy mobile apps or SMS platforms for waste reporting, collection scheduling, and community engagement. Establish digital monitoring systems to track waste flows, improve accountability, and measure progress towards circular economic goals.

Karu Local Government Area could transition to a more sustainable and effective waste management system, benefiting the environment, economy, and society from implementing these recommendations.

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